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ABSTRACT

One of the most widely respected features of English orthography is its sequential redundancy. Its psychological reality is evidenced by the relative ease with which good readers can encode sequentially redundant nonwords as compared to arbitrary strings of letters. Its psychological importance is implicated by evidence that this advantage is generally depressed or absent among poor readers. A knowledge of orthographic redundancy facilitates the encoding of the identities and the order of letters in orthographically regular strings. Automatic preliminary syllabification is mediated by the reader's knowledge of orthographic redundancy. Orthographic redundancy is an essential property of our written language and the primary domain of its utility is in the reading of multisyllable words. Written English is a three-tiered system: it is at once an alphabet, a logography, and a syllabary. This insight adds meaning to our knowledge that logographies and syllabaries have not, in history, been abruptly displaced by alphabetic scripts, but instead, have evolved gradually into them. (HOD)

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CENTER FOR THE STUDY OF READING

Technical Report No. 192

WHAT GOOD IS ORTHOGRAPHIC REDUNDANCY?

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Abstract

Across the literature on visual word recognition, one of the most widely respected features of English orthography is its sequential redundancy. The fact of this redundancy can be demonstrated statistically (Shannon, 1948). Its psychological reality is evidenced by the relative ease with which good readers can encode sequentially redundant nonwords as compared to arbitrary strings of letters (e.g., Adams, 1979a; Baron & Thurston, 1973; Gibson, Pick, Osser, & Hammond, 1962; Johnston & McClelland, 1974; Krueger, 1979; Massaro, Venezky & Taylor, 1979; Mewhort, 1974; Miller, Bruner, & Postman, 1954). Its psychological importance is implicated by evidence that this advantage is generally depressed or absent among poor readers (e.g., Adams 1979b; Frederiksen, 1978). Not surprisingly, means for recognizing and taking advantage of orthographic redundancy have come to reside at the core of many current theories about the knowledge and processes involved in word recognition (e.g., Adams, 1979a; Estes, 1975a,b; Johnston, 1978; LaBerge & Samuels, 1974; Massaro, 1975; McClelland, 1976; Rumelhart & Siple, 1974; Smith, 1971).

The purpose of this paper is not to challenge the assumption that orthographic redundancy is of central importance to the word recognition process. It is, instead,

to ask why. What advantage does the reader gain from orthographic redundancy, and why would such redundancy be built into a written language in the first place?

The Problem

In a message with no sequential redundancy, the probability with which any element will occur is independent of the identities of preceding elements. Sequential redundancy, then, corresponds to the extent to which knowledge of one element or fragment of a message can help one to predict what the next element will be. Such redundancy greatly reduces the criticality of any one element to the message as a whole. As it allows the recipient of a message to predict ensuing elements, it reduces the amount of care and effort that need be allocated to their decoding. As it allows the recipient to detect and correct anomalous elements, it reduces the consequence of errors in transmission or reception. Thus, wherever the signal is noisy or the receiver has limited processing capacity (or is otherwise error-prone), redundancy may be critical to the accurate communication of a message. In particular, sequential redundancy offers obvious advantages in the case of most oral language situations.

A moment's reflection makes clear that English orthography carries considerable redundancy. For example, if

a word begins with t, its second letter will probably be an h, an r, a w, or a vowel, and there are substantial differences among the likelihoods of these alternatives as well. However, the advantages of sequential redundancy are not obvious in the case of orthography. First, spelling errors and obfuscating noise are rare in printed text. Second, written text, unlike speech, is permanent; and readers, unlike listeners, can therefore process and reprocess any fragment of a message for as long as they need. Third, when errors in letter or word recognition do occur, redundancy at the syntactic and semantic levels may provide sufficient means for coping (see Smith, 1973). Thus, orthographic redundancy would not seem to be essential for containing errors in written communication.

Further, when concern is turned from letter identification to word identification, it can be argued that the sequential redundancy of English orthography is actually disadvantageous for the reader. Because of sequential redundancy, each letter of an English word yields a certain amount of information as to what the next letter will be. But in direct proportion to this interletter facilitation, the amount of information a letter can provide as to what the word will be, must be reduced. This point may be best illustrated through the extreme case. Suppose a reader has encountered a

q in an English text. She or he may be virtually certain that the next letter will be a u. Yet confirming that the next letter is indeed a u, will not bring the reader any closer to knowing what the word will be. With respect to word identification, the sequence, qu, provides no more information than does the single letter q.

The sequential constraints of English are also quite costly in terms of notational efficiency. Shannon (1948) has estimated the redundancy of English orthography to be 50%. Note that this figure pertains strictly to orthography; it does not include semantic or syntactic redundancy. In other words, our texts are roughly twice as long as they need be, solely because of the way we spell. An alternate way to appreciate the burden of redundancy is to consider how concise our orthography could be without it. From an alphabet of 26 letters, we could generate over 475,254 unique strings of 4 letters or less, or 12,376,630 of 5 letters or less. Alternatively, we could represent 823,543 unique strings with an alphabet of only seven letters, or 16,777,216 with an alphabet of only eight. For comparison, the total number of entries in Webster's New Collegiate Dictionary (1977) is only 150,000. By eliminating redundancy, we could thus realize a substantial savings in our orthographic code, and we could do

so even while leaving considerable margin for systematically locating our words in the letter space -- for example, words could be designated so as to minimize orthographic overlap or to create clusters corresponding to semantic, syntactic, or phonetic similarities.

All such considerations aside, the facts remain that English orthography is highly redundant and that sensitivity to this redundancy seems to be well developed among good readers. The remainder of this chapter will be directed toward the task of puzzling out why this should be so. Each of the sections to follow will take up one class of explanations of the utility of orthographic redundancy and explore its adequacy.

The Role of Spelling-to-Sound Correspondences

The redundancy of our written language is owed in large measure to the fact that it is alphabetic. Only certain sequences of phonemes are permissible within our spoken language, and, even among those, some occur far more frequently than others. To the extent that orthographic redundancy is a consequence of spelling-to-sound correspondences, our question shifts: Are spelling-to-sound correspondences useful to the reader, and can they explain the apparent utility of orthographic redundancy?

Smith (1973) has argued that our alphabetic system is designed primarily for the benefit of the writer, and further, that "anything tending to make writing easier will make reading more difficult" (p. 117). To be sure, our alphabetic system has certain drawbacks for the reader. In particular, phonemes, or the elementary speech sounds to which our letters refer, do not occur as discrete elements in our spoken language. Rather, as Rozin and Gleitman (1977) put it, they are "shingled" together in the continuous sound wave of speech. The mapping of spelling to sound, therefore, requires an explicit and somewhat artificial analysis of our aural language. Indeed, there is considerable evidence that such analysis is especially difficult for young children (Liberman, Shankweiler, Liberman, Fowler, & Fischer, 1977; Rozin & Gleitman, 1977) and more generally, that the phoneme, as a psychological unit, is relatively inaccessible to consciousness even for adults (Savin & Bever, 1970; Warren, 1971). Compounding this problem, the letter-to-phoneme correspondence of English is by no means one-to-one. Efforts to systematize the relationship have resulted in hundreds of correspondence rules (e.g., Berdiansky, Cronnell, & Koehler, 1969, cited in Smith, 1973; Hanna & Hanna, 1959; Wijk, 1966). Thus, as simple and elegant as the alphabetic principle might seem to mature readers of English, phonics may stand as a

linguistically abstruse and cumbersome technique for the novice (see Gleitman & Rozin, 1977; Rozin & Gleitman, 1977).

But our alphabetic system also has much to recommend it. Chomsky (1970) has argued that disillusionment with the efficiency of the system derives from a myopic understanding of the spelling-to-sound correspondences it captures. Phonemes, he argues, are but a superficial aspect of the language. Neither linguistic theory nor psychological evidence provides reason to believe that they are functionally significant. When our spelling-to-sound correspondences are traced, not to phonemes, but to the broader phonological and lexical structure of our language, he sees the system as a nearly optimal means of representing the spoken language. The orthography conveys the phonological information necessary to access a word's morphemic segments. The orthography omits (thereby incurring much of its reputation as irregular) such phonological nuances as stress placement and the phonetic variants of the vowels, which are, in any case, given, once the deep representation of the word has been found -- they are integral to the system for producing and understanding speech. Thus, according to Chomsky, the difference in the sound of the medial vowel in Arab vs. Arabian, Canada vs. Canadian, or melody vs. melodious does not reflect irregularity of our

spelling-to-sound system, but regularity of our phonological system.

There are also, of course, the traditionally cited advantages of our alphabetic system. First, the possibility of "sounding out" visually unfamiliar words affords an important degree of independence for the beginning reader. Second, an alphabetic system is purported to hold a mnemonic advantage for the reader and writer over scripts, such as Chinese, that are not based on phonology. In support of this contention comes the observation that although the average English-speaking high school student can read about 50,000 words, the Chinese scholar can rarely name more than 4,000 logograms (Rozin & Gleitman, 1977).

Given the nature of our written language, a more direct argument can be made for the mnemonic importance of spelling-to-sound correspondences. Let me relate this argument in the way I came to appreciate it. Many schools for deaf children in this country teach reading through phonics. On first learning this, I was dismayed: how counterproductively egocentric of us to make written English parasitic on the spoken English which the children generally do not have. It seemed to me that for deaf children, any useful dependency between the modalities should run in the

opposite direction--that spoken English, if it need be taught at all, should be built upon pre-established knowledge of written English. Then it came to me.

Imagine that I set before you the task of learning a notational system for the English language. Within this system, words would be represented by ordered sets of just a few elementary symbols. More specifically, let us suppose that the system included 26 such symbols but, just to make it interesting, let's say that some 90% of the time I would only use 15 of them (computed from Mayzner & Tresselt, 1965). Let us further imagine that the composition of the symbol set has been essentially arbitrary: the individual elements have no a priori iconic significance; they were not designed with an eye toward maximizing visual discriminability; they are, in themselves, completely meaningless; and they are unrelated to the sounds of articulatory structures of the words in whose representations they occur. Thus, the only basis you will have for memorizing the words within this system is in terms of the specific, ordered sets of elements by which I designate them. Half of the words I would present would be quite short, consisting of seven elements or fewer; the remainder could be indefinitely long although relatively few would exceed fifteen elements (Miller, Newman, & Friedman, 1958). The criterion

for passing is that you, like the average American high school student, learn the combinations and permutations of elements corresponding to at least 50,000 words.

What an awful task. And yet, the system I have just invented corresponds very closely to our own system of writing. The major difference is that my system lacks any symbol-to-phoneme correspondences, and that is, of course, the point. However fuzzy one's knowledge of the spelling-to-sound (or spelling-to-articulation) correspondences of English, it must be of invaluable assistance in learning the identities and orders of the letters of English words. It is no wonder that poor reading and poor phonological recoding skills are found to be so highly correlated among young readers (e.g., Barron, 1978b; Jorm, 1979; Liberman, et al., 1977).

It has been suggested that the shapes of whole words offer an alternate set of cues for word identification (e.g., Johnson, 1975; Smith, 1971; also see review by Woodworth, 1938). In defense of this notion, Brooks (1977) has shown that if words are presented to students in distinctive typographies, learning is facilitated. Perhaps this would be a useful technique for teaching deaf children to read. On the other hand, Groff (1975) has shown that given normal typography, the visual configurations of words are poor clues

to their identities. And, in any case, the shapes of words or frequent letter clusters evidently do not contribute to word identification by mature readers (Adams, 1979a).

In short, if the alphabetic nature of written English is the source of orthographic redundancy, it may also be its defense. Even if Smith's (1973) contention were true in the extreme, that is, even if spelling-to-sound correspondences proved to be critical only for the writer, that would be justification enough for the existence of orthographic redundancy. However, I am convinced that spelling-to-sound correspondences are at least as important to the reader, and it follows that orthographic redundancy must also be.

Even so, a full explanation of the apparent role of orthographic redundancy in word recognition cannot be discovered through considerations of spelling-to-sound correspondences. Although they lead to the conclusion that orthographic redundancy is (indirectly) useful for the reader, they do not imply that it is used by the reader. Direct phonemic translation of the written word depends only upon knowledge of the relationships between spelling and sound. Phonological translation, as Chomsky (1970) would have it, additionally requires knowledge of underlying morphology and the relationships among sounds. Knowledge of the

relationships among the letters of a written word is inherently required by neither approach. Rather, for both, orthographic redundancy is incidental to the end product of the translation process as it is but a concomitant of the sound structure of the language.

Of course, if spelling-to-sound translations were found to be an integral and automatic component of the word recognition process, the apparent role of orthographic redundancy would, by corollary, be explained. But again we have hit a dead end. Lexical access apparently does not depend on phonological recoding, even among young children (see reviews by Barron, 1978a, and Spoehr, 1980).

This is not to say that phonological recoding is not involved in skilled reading. To the contrary, there is increasing evidence that it is. However, its function seems primarily one of facilitating retention for the words of the text until the complete phrase or sentence in which they occur has been read and comprehended (Barron, 1978a; Kleiman, 1975; Levy, 1975; 1978), and it appears to be a consequence rather than an antecedent of lexical access (Forster & Chambers, 1973; Stanovitch & Bauer, 1978). That such recoding occurs among readers of Chinese (Tzeng, Hung, & Wang, 1977) suggests that it can be mediated by processes that are not at all

associated with spelling-to-sound correspondences. There is some evidence that, even among readers of English, phonological recoding does not proceed by any direct path from letter-to-sound (Glushko, in press).

Considerations of spelling-to-sound correspondences raise another, more subtle question about the orthographic redundancy of English. Namely, of what value are vowels? As the six primary vowels comprise roughly 39% of the letters in English text (from Mayzner & Tresselt, 1965), they contribute heavily to its redundancy -- more heavily, in fact, than can be defended in the interest of spelling-to-sound correspondences. It is the vowels that are responsible for the majority of spelling-to-sound irregularities of English. Indeed, the descriptive advantage of Chomsky's (1970) approach to spelling-to-sound correspondences derives largely from his dismissal of much of the variation in vowel-to-phoneme mapping as irrelevant to our alphabetic system or at least beyond its province.

Given the amount of redundancy that is carried by the vowels, one might further suspect that they contribute especially little information with respect to the identities of words. Confirming this suspicion, Miller and Friedman (1957) found that when English passages were abbreviated by

removing all of the vowels and spaces, people could regenerate them almost perfectly. In contrast, when a similar proportion of random letters was removed, median reconstruction accuracy was less than 20%. It is interesting to note that in reformed alphabets, such as UNIFON and the i/t/a, the number of different vowels is more than tripled. In this way the reformed alphabets simultaneously offer a means of reducing the redundancy attached to the vowels and of increasing their phonemic significance (see Aukerman, 1971).

It may be that vowels contribute minimally to word identification in spoken language as well. It is, after all, the vowel sounds that vary most noticeably across dialects. However, a certain variety of vowel sounds is essential in spoken language, as it allows the listener to estimate the size of a speaker's vocal tract and, in turn, to convert acoustical into phonemic information (Gerstman, 1968). Clearly no parallel function is possible or necessary in written language, which leads one to wonder why vowels need be represented in the script at all. They typically are not represented in the otherwise "alphabetic" Semitic scripts. Indeed, they were not represented in the Semitic ancestor of our own script.

Such reservations are peaked by the observation that the task of segmenting vowels from consonants is the most troublesome prerequisite to learning an alphabetic script (e.g., Gleitman & Rozin, 1977; Liberman, et al., 1977). Maybe vowels really are more a hindrance than a help to the reader. Alternatively, given that the vowels seem to contribute little else of value to our orthography, perhaps they hold a critical clue with respect to the role of redundancy in word recognition. We will return to this possibility in a later section of this paper.

Sequential Redundancy and Letter Identification

It has often been suggested that sequential redundancy is used by skilled readers to facilitate letter recognition (Adams, 1979a; Broadbent, 1967; Estes, 1975a,b; Massaro, 1975; Morton, 1969; Rumelhart & Siple, 1974; Smith, 1971). The essential quality of a redundant string is, after all, that its elements do not occur independently of one another. The task of visual feature identification in reading could be substantially reduced if it were complemented or guided by knowledge of interletter constraints. Under this view, people with keener sensitivity to the sequential redundancy of our orthography should be better readers, not because they have overlearned their phonics, but because they would need invest less effort in visual feature extraction.

The hypothesis that sequential predictability enhances perceptibility finds support from the many demonstrations that pseudowords are more readily perceived than unrelated strings of letters (for a review, see Adams 1979a). However, more refined evidence of such facilitation has been hard to come by. Several investigators have measured the speed with which people can search through more and less constrained nonwords for prespecified target letters (Gibson, Tenny, Baron, & Zaslow, 1972; James & Smith, 1970; Krueger, 1970a, b; Krueger, Keen, & Rublevich, 1974; Massaro, Venezky, & Taylor, 1979). The advantages of this paradigm are that it minimizes confoundings of guessing and memory. Its major disadvantage, with respect to the issue at hand, is that the visual processing it requires may be so much more cursory than that required for word recognition as to preclude meaningful comparisons. In any case, the results from these studies have been mixed, and even when faster search times have been found with more tightly structured strings, the effect has been quite small (Krueger, 1970a; Krueger, et al., 1974; Massaro, et al., 1979).

Results from studies requiring more thorough visual processing have been no more positive. Broadbent and Gregory (1968) and Owsowitz (1963, cited in Broadbent & Gregory, 1968)

found that bigram frequency had no significant effect on tachistoscopic recognition thresholds for high frequency words. Moreover, for low frequency words, the bigram effect was significant but backwards: low frequency words with low bigram counts were perceived significantly more readily than those with high bigram counts. Analogous results have been obtained by Rice and Robinson (1975) through a lexical decision task. Reducing paradox to confusion, Beiderman (1966) and Rumelhart and Siple (1974) found low frequency words with high bigram frequencies to be more perceptible than those with low bigram frequencies. Finally, filling in the spectrum of possible results, McClelland and Johnston (1977) found virtually no effect of bigram frequency on the perceptibility of either words or pronounceable nonwords under either full-report or forced-choice procedures.

It seems that, excepting the robust pseudoword/nonword difference, facilitative effects of orthographic redundancy on performance have consistently been found only through experimental tasks involving relatively heavy memory requirements (Krueger, 1970a; Massaro & Taylor, 1979; Massaro, Venezky, & Taylor, 1979; Miller, Bruner, & Postman, 1954). But, given the well known relation between information and memorability (Miller, 1956), it is difficult to ascribe such effects to perceptibility.

Even so, our failure to demonstrate that the perceptibility of words and pseudowords varies with their sequential predictability cannot be taken as evidence against the notion of interletter facilitation. I have elsewhere (Adams, 1979a) proposed a model of word recognition that would predict no such trend, even though one of its central assumptions is that sequential redundancy facilitates letter recognition. The reason for this seeming contradiction is that the model carries the additional assumption that letter recognition is facilitated by lexical knowledge. As letter cluster frequency and word frequency are highly correlated, these two sources of knowledge normally work together to facilitate word perception; in effect, they provide redundant information about redundant information. The problem with studies like the aforementioned is that they have necessarily focused on the exceptions to this rule -- on the cases in which lexical and orthographic knowledge yield conflicting biases. To develop this explanation more completely, it is necessary to consider the model in some detail.

The basic assumption of the model is that the perception of an orthographic string consists in the activation of appropriate letter and word recognition units in memory. Facilitative effects of orthographic and lexical familiarity

are built into the model through the old idea that any two units in memory that are reportedly activated at the same time become associated such that the activation of one facilitates the activation of the other.

The network of letter recognition units is schematized in Figure 1. The circles in Figure 1 represent letter recognition units, and the arrows represent the associations between them. The solid circles correspond to units receiving activation both directly from the stimulus and indirectly through other activated units in the network; the broken circles correspond to units receiving indirect activation only. The fraction of activity which one unit relays to another is supposed to depend on their history of co-occurrence; within the model these weightings are estimated as interletter transition probabilities (from Mayzner & Tresselt, 1965). The directions of the arrows between the units are not meant to constrain the flow of activity between units, but merely indicate the direction of the transition. For example, when the H unit in Figure 1a is activated, the facilitation of the T unit is weighted by .442 for T's to the immediate left of the H and by .024 for T's to its immediate right.[1]

Insert Figure 1 here

The relation between the letter and word recognition units is schematized in Figure 2. Like the interletter associations, the associations between the letter and word units are supposed to be bidirectional: as any letter unit becomes activated, it relays activation to every word unit to which it belongs; as any word unit becomes activated it proportionately and reciprocally relays activation to the letter units corresponding to each of its component letters. The strengths of the associations between the letter and word units are assumed to be a function of word frequency; the weightings given are from Carroll, Davies, & Richman's (1971) Standard Frequency Index.

Insert Figure 2 here

A critical assumption of the model is that processing occurs concurrently within and across all levels. Visual features are extracted from the letters of the stimulus in parallel, but with a left-to-right bias in attention, and each

feature is mapped onto all compatible letter recognition units. As soon as any unit in memory becomes activated in the least, it relays proportionate activation to all of its associates.

Thus, if the system consisted only of the letter recognition network, a strong effect of sequential redundancy would be predicted. For strings composed of highly probable bigrams, like those in Figures 1a and 1b, the relevant letter recognition units would simultaneously receive direct, visual activation from the stimulus and strong indirect activation from each other. In contrast, for strings composed of unlikely bigrams, like the one in Figure 1c, facilitation through interletter association would be minimal and perception would depend almost entirely on direct activation from the stimulus.

It is because of the influence of the word recognition units that the bigram effect is expected to be invisible in experiments like those described earlier in this section. For high-frequency words, the priming afforded by the word recognition units should be so strong as to obscure any differences owing to bigram probability. In contrast, for low-frequency words, associations between the letter and word recognition units should act to undermine the facilitative

effects of high bigram frequency. After all, if the bigrams comprising a low-frequency word or pseudoword have occurred frequently, it must be because they have occurred in many other words or at least in a few high-frequency words. Thus, the priming they elicit from the word recognition units will be misleading -- it will act to disperse activation counterproductively across the letter recognition network. As a consequence, despite the advantage they may accrue through the network of interletter associations, low-frequency words with high bigram frequencies may be expected to require at least as much visual attention as low-frequency words with low bigram frequencies. Notably, the model nonetheless predicts that low-frequency words will be more perceptible than strings of unrelated letters since the latter will receive no facilitation through either type of association, but lots of interference from both.

Sequential Redundancy and Letter Order

Estes (1975a,b, 1977) has hypothesized that an important function of sequential redundancy is that of helping the reader to encode the order of the letters in an orthographic string. The motivation for this hypothesis stems from evidence that the visual system's capacity for processing

spatial information is, in itself, too limited to support the speed and accuracy with which skilled readers can recognize words.

According to Estes (1972), the visual system's primary means of encoding the location of information in the visual field is in terms of the input channel through which it is passed from the retina to the feature detectors, but the density of these input channels is limited, especially beyond the fovea. Thus, when letters are arrayed closely together, and especially when this happens towards the periphery of the field, their features will necessarily be shipped through the same input channel. As a consequence, there will be no sensory basis for distinguishing their respective locations. In keeping with this theory, Estes, Allmeyer, and Reder (1976) have shown that when subjects are restricted to a single visual fixation and asked to report unrelated letters from a densely packed visual array, the frequency of positional errors increases significantly towards the periphery of the field. In support of their hypothesis that such positional uncertainty arises from sensory rather than, for instance, memory limitations, they also found that the frequency of transposition errors did not decrease when viewing time was extended from 150 to 2400 milliseconds. Using much briefer

exposure durations (5 to 74 milliseconds) and foveal displays, I have also found evidence that different processes are responsible for the extraction of identity and positional information from an orthographic string, and, moreover, that it takes the system less time to encode item information accurately than to encode positional information accurately (Adams, 1979a).

Importantly, in letter recognition experiments with normal adult readers, transposition errors occur frequently only when the stimuli are strings of unrelated letters; transposition errors all but disappear when the stimuli consist of words, pseudowords, or frequent bigrams (Adams, 1979a; Estes, 1975a; Johnston, 1978; McClelland, 1976). That is, performance with unrelated strings of letters is typically consistent with the evidence that the visual system's capacity for processing spatial information is both crude and sluggish; performance with sequentially constrained strings of letters is not. The hypothesis that good readers use knowledge of sequential redundancy to compensate for positional uncertainty in letter perception follows easily.

These theories also carry several implications with respect to problems that are likely to beset readers with poorly developed knowledge of sequential redundancy. First,

such readers are liable to transpose letters frequently unless they are reading print that is sufficiently large or spaced out to ensure that no two letters will share the same visual input channel. (We note the time-honored practice of setting primers in large type.) Second, given smaller print and no knowledge of sequential redundancy, the only means a reader would have of avoiding transpositional errors would be to fixate on words repeatedly. (We note that a characteristic difference between better and worse readers is in the number of times they fixate each word while reading connected prose [Kolers, 1976].) Letter reversals and transpositions are frequently observed among very poor readers but have traditionally been interpreted as evidence of neurological dysfunction, or so-called "primary dyslexia." The present theories suggest that these behaviors may reflect nothing more than inadequate knowledge of sequential redundancy. In keeping with this possibility I have recently found experimental evidence that suggests letter ordering difficulties are very common among below-average readers in general -- if less extreme than among "dyslexics" (Adams, 1979b).

This experiment involved sixteen paired high school volunteers who were divided, eight and eight, into good and

poor readers on the basis of their performance on the Nelson-Denny Reading Comprehension Test. The mean percentile scores for the good and poor readers were 95.6% and 47%, respectively.

All subjects were shown two series of quadrigrams at very brief exposure durations. Their task was to report all of the letters of each quadrigram in the correct order, guessing if necessary. One of the series of quadrigrams consisted of nonwords only -- that is, of quadrigrams with very low bigram frequencies. The other series consisted of equal numbers of high frequency words, pseudowords with high positional bigram frequencies, and nonwords, randomly interspersed. The nonwords and pseudowords that were presented to any one subject were, in fact, anagrams of the words presented to another, such that the composition of the quadrigrams, in terms of single letters, was fully controlled across subjects.

The rationale for this design grew from Aderman and Smith's (1971) demonstration that the functional units in the perception of printed English may be either single letters or spelling patterns, depending on the perceiver's set or expectations. In particular, it was assumed that when the stimulus series consisted of nonwords alone, the subjects' functional perceptual units would be single letters.

Performance should, in this case, reflect the subjects' basic ability to extract identity and order information from the stimulus. In contrast, when nonwords were interspersed with words and pseudowords, subjects should tend to use orthographic patterns as the functional perceptual units. If, as hypothesized, a basic role of orthographic knowledge is that of rectifying the perception of letter order, then its application should result in an active misordering of the letters of the nonwords. Moreover, if a characteristic difference between good and poor readers is in their knowledge of orthographic redundancy, then the good readers should be more prone to misorder the letters of the nonwords in the mixed condition than the poor readers.

The results of this experiment were wholly consistent with these expectations. The good readers were significantly worse at reporting the letters of nonwords in their correct positions when the nonwords were intermixed with words and pseudowords than when they were presented alone; for the poor readers there was no difference. Moreover, in the mixed condition, poor readers were significantly less accurate than good readers at identifying and ordering the letters of pseudowords, but they were every bit as accurate as the good readers with words. While the latter contrast corroborates

the hypothesis that good and poor readers tend to differ in their sensitivity to orthographic structure as distinct from whole, familiar words, the results of the experiment as a whole corroborate the hypothesis that such sensitivity is directly related to the encoding of letter order information.

Orthographic Redundancy and the Perception of Multisyllable Words

In the last two sections, I have presented arguments that knowledge of orthographic redundancy facilitates the encoding of the identities and the order of letters in orthographically regular strings. These arguments suffer a common drawback, however, with respect to explaining the utility of orthographic redundancy. Specifically, it seems that any facilitation that orthographic redundancy might provide is superfluous if the reader is visually familiar with the word as a whole. In the experiment described in the last section (Adams, 1979b), the effect of orthographic knowledge on the encoding of letter order was apparent only for nonwords and pseudowords: correctly identified letters of words were almost never misordered by either good or poor readers. Similarly, in the section on orthographic redundancy and letter recognition, the only reliable evidence that recognition of one letter may prime or facilitate the recognition of its most

likely neighbors came from comparisons of people's performance with pseudowords and nonwords.

In this section, I will, nevertheless, argue that orthographic redundancy is an essential property of our written language. I will argue that knowledge of orthographic redundancy is critical to the skilled reader and that its utility derives primarily from the two types of facilitation described in the two preceding sections of this paper. However, I will argue that the primary domain of its utility is in the reading of multisyllable words.

To begin this argument, let us reconsider the value of vowels. To the extent that vowels are not phonemically informative, the English writing system is not really an alphabet, but some hybrid between an alphabet and a syllabary. Of what advantage, we might ask, is such a hybrid over a straightforward syllabary. After all, it has been repeatedly argued that syllables are psychologically more accessible than phonemes for both children and adults (e.g., Liberman et al., 1977).

A general explanation offered by Gleitman and Rozin (1977) is that the desirability of syllabic script is a function of representational efficiency. Thus, for classical

Chinese, in which the number of syllables approaches the number of words, a syllabary offers little savings over a logography. In contrast, for Japanese, which can be adequately represented with about 50 syllabic signs, a syllabary offers tremendous economy over a logography. A syllabary would be more economical than a logography for English as well. However, English is estimated to consist of as many as 5,000 distinct syllables (Rozin & Gleitman, 1977). Thus, strictly in terms of the number of symbols or, equivalently, the amount of rote memorization required, our alphabet of 26 letters is far more manageable than a pure syllabary would be.

But why vowels? With the exception of relatively few institutionalized perversities of our spelling system (e.g., kn-, -ght, wr-), the differences in the predictability with which one consonant follows another can be traced to the sound structure of the language. For example, the fact that d more frequently precedes r than n is a consequence of the alphabetic principle; it is a relatively faithful reflection of the way we talk. With respect to consonants, then, orthographic redudancy can be seen as a concomitant of phonemic information. However, as previously discussed, the same cannot be said for vowels. In the interest of

phonological information, it would seem that a well designed alphabet ought to include either more vowels than are included in our own alphabet, or none at all. Yet I shall argue that the primary function of vowels within our writing system is orthogonal to their phonological significance. Their primary function is that of preserving the syllable as a perceptual unit, and as such derives directly from the redundancy they carry.

The importance of vowels to the decipherability of our script can be illustrated through variations on the very technique that has so often been used to argue their superfluousness:

> Th bsc dmnstrtn s tht txt s stll mr r lss lgbl whn th vwls hv bn rmvd.
>
> Th prps f th frst vrtn n ths thm s t dmstrt tht th trnsprnc f th nttn dcrss prcptsl whn th txt s cmpsd f rltvl nfrqnt wds nd bcms vrtll mpntrbl f wds r nt smntcll r sntctcll prmd, vz., prcpn, drcl, trnp, cstnt, nnsns.[2]

Th* p*rp*s* *f th* s*c*nd v*r**t**n *n th*s th*m* *s t* d*m*nstr*t* th*t th* *mp*rt*nc* *f v*w*ls c*nn*t b* f*lly *xpl**n*d *n t*rms *f th**r ph*n*m*c s*gn*f*c*nc*, f*r th* l*g*b*l*ty *f th* t*xt *s *lm*st c*mpl*t*ly r*c*v*r*d *f th' v*w*ls *r* n*t *m*tt*d b*t r*pl*c*d w*th s*m* ph*n*m*c*lly n*ns*gn*f*c*nt s*mb*l, *nd th*s *s tr** *v*n f*r l*ng, *nfr*q**nt, *nd c*nt*xt**lly *npr*d*ct*bl* w*rds, v*z., d*ff*d*l, h*rps*ch*rd, r*ct*ngl*, br*nt*s**r*s.

The idea that syllabic encoding is an important component of the word recognition process has been gaining support in recent years (e.g., Rozin & Gleitman, 1977; Spoehr & Smith, 1973, 1975; Stanners, Neiser, & Painton, 1979; Taft, 1979). Most of this research has focused on the role of syllabic units in the processes of phonological recoding or lexical access. Although a few investigators have suggested that the syllable influences the very course of perception (e.g., Gibson, Pick, Osser, & Hammond, 1962; Smith & Spoehr, 1974), this notion has always been shackled with a parsing problem. Specifically, to perceive the letters of a word in syllabic units, one would seemingly need to know where the syllables begin and end before knowing what they were. Where the units

of perception are letters or words, unitization could be based on the physical cue of interitem spaces, but no obvious physical cue exists in the case of syllables.

Nevertheless, Mewhort and Beal (1977) have developed evidence that the syllabic structure of a word does indeed guide the visual processing of its letters. In Mewhort and Beal's first experiment, the stimuli were eight-letter words, such as OBTAINED. The letters of the words were arrayed, one by one, from left to right or right to left, for 5 msec each; the interstimulus interval, or the time between the offset of one letter and the onset of the next, varied across trials from 0 to 250 msec. Regardless of the order in which the letter appeared, subjects were able to recognize the words almost perfectly with 0 msec interstimulus interval. However, as the interstimulus interval was lengthened, word recognition accuracy declined by about 50% in the left-to-right condition. That is, subjects' word recognition processes were somehow disrupted by the nonsimultaneity of the letters. In the right-to-left condition, the number of words which subjects recognized correctly fell nearly to zero with increases in the interstimulus interval. Moreover, this decline in accuracy was mirrored by a shift toward encoding the letters from right-to-left. This suggests that the word recognition system

may be inherently biased toward accepting information in left-to-right order. Alternatively, the subjects' difficulty in the right-to-left condition might have resulted not from the spatial order of letter presentation per se, but from a consequent disruption in their ability to recognize or exploit the sequential dependencies of the string.

To evaluate these explanations, Mewhort and Beal included two more conditions in the experiment. These conditions were like the first two except that the stimulus words were spelled backwards, e.g., DENIATBO. Thus, when these backwards words were arranged from left-to-right, the spatial order of letter encoding was normal, but the sequences of letters were reversed; when arrayed from right-to-left, the sequences of letters were normal, but the spatial order of encoding was reversed. Mewhort and Beal's subjects recognized virtually none of the backward words at 0 msec interstimulus interval, regardless of whether the array stepped from left-to-right or right-to-left. For the left-to-right arrays, there was virtually no improvement in performance with increases in the interstimulus interval. For the right-to-left arrays, the proportion of correctly recognized words approached .50 as the interstimulus interval was increased, and again, this change in report accuracy was mirrored by a shift toward encoding the

letters in a right-to-left order. In short, the results of these conditions indicate that the word processing system is biased for left-to-right input but that, regardless of the spatial direction of input, the probability of recognizing a word under letter by letter presentation conditions depends strongly on whether the letters are encoded in the order or sequence in which they normally occur.

In a previous study, Mewhort (1974) obtained a virtually identical pattern of results using pseudowords instead of words. Mewhort and Beal's effects, therefore, cannot be attributed to the meaningfulness or holistic familiarity of the stimuli. Nor can they be attributed to differences in the subjects' ability to recognize the individual letters of the strings: Mewhort (1974) found that performance was invariant across comparable experimental conditions with first-order approximations (i.e., nonwords with no sequential redundancy). By process of elimination, Mewhort and Beal's results would seem to reflect people's dependency on structural properties of the strings.

Following Smith and Spoehr (1974), Mewhort and Beal hypothesized that their effects reflected a disruption of the subjects' ability to parse the strings into syllabic units during scanning. To test this idea, they repeated the first

two conditions of their first experiment, sequentially presenting fragments of words from left-to-right or right-to-left. However, in this experiment, the fragments were not single letters, but groups of letters. For half the subjects, the letter groups corresponded to syllables (e.g., IN-DUS-TRY, SPE-CI-FIC); for the other half, they did not (e.g., IND-UST-RY, SP-ECI-FIC). Mewhort and Beal found that, except at 0 msec interstimulus interval where accuracy was generally very high, performance was more accurate with the syllabic groups of letters than with the nonsyllabic groups regardless of the spatial order of presentation. Moreover, very few errors occurred in the left-to-right syllabic condition at any interstimulus interval. This consistently high level of accuracy contrasted not only with the performance in the other conditions of this experiment, but with the performance with left-to-right letter-by-letter presentation of forward words in Mewhort and Beal's first experiment. The data thus lend strong support to the hypothesis that the syllable is a fundamental unit of encoding in word perception.

Finally, to ascertain whether the syllabic effect accrued in the course of scanning or afterwards as the result of short-term memory operations, Mewhort and Beal ran one more

experiment. As before, the words were arrayed in syllabic or nonsyllabic letter groups. But this time, the letter groups were arranged in vertical columns instead of horizontal rows. This procedure was intended to preclude normal left-to-right scanning while ensuring that the letters nonetheless be entered into short-term memory, group by group or syllable by syllable. Mewhort and Beal found that across interstimulus intervals of 0 to 625 msec, mean word recognition accuracy hovered between 20% to 40%. Further, there was no difference in accuracy between the syllabic and nonsyllabic conditions. It thus seems that normal scanning is critical to the word recognition process. And, adding Bryden's (1970) evidence that the recognition of strings of unrelated letters is not impaired by such vertical formatting, it seems, in particular, that normal scanning is critical to the reader's ability to recognize and exploit the syllabic structure of an orthographic string. By implication, the word recognition system must indeed have some preliminary means of segregating syllables or identifying syllable boundaries.

I would like to suggest that such automatic preliminary syllabification is mediated by the reader's knowledge of orthographic redundancy. In particular, I would like to suggest that it could be mediated by a network of associated

letter units like that proposed in the word recognition model described earlier (Adams, 1979a) Again, within that model, it is assumed that letters of an orthographic string, or more precisely, the features of those letters, are encoded in parallel, but with a left-to-right bias in attention. When any given letter unit in memory is stimulated, it will prime or relay activation to all other units with which it is associated. The strengths of an association between two letter units is assumed to be a direct function of the relative frequency with which one has followed or preceded the other in the reader's experience. Thus, the effect of the interletter priming will be that the unit corresponding to each of the component letters of a highly redundant sequence will simultaneously receive strong activation from the units corresponding to its neighbor on either side as it receives visual activation from the stimulus. In this way, the perception of the entire sequence will be greatly facilitated. Moreover, because the associations are between ordered pairs of letters, the perceived letters will become encoded in memory as a cohesive, ordered sequence. In contrast, when the transition probability from one letter to another is relatively low, the association between them will be weak. In this case there will be little interfacilitation between them in the course of perception, and, once perceived, there will be little cohesion between their internal representations.

Provided that interletter transition probabilities or, equivalently, sequential redundancy is relatively high within syllables and low between them, the workings of such a network would automatically produce syllabic parsing in the course of letter perception. The syllabic structure of a word would be given by the relative strengths of the associations between the units corresponding to adjacent letters. Because of their mutual facilitation, the letters within a given syllable will be perceived almost concurrently. In contrast, because the first letter of a new syllable will not enjoy the same degree of facilitation and because the allocation of attention tends from left to right, its perception will lag in time. In addition, the strong associations within a syllable will reinforce perception of, and memory for, the order of the letters within the syllable. This is especially important for long words since, as Wolford (1975) has demonstrated, the tendency toward perturbations in letter order increases when there are no spaces between letters (as there are between words) and with distance from the fovea. The associations between letter recognition units will provide little reinforcement with respect to the order of an adjacent pair of weakly associated letters. Provided, however, that such pairs occur only at syllable boundaries, this will cause little difficulty: Each of the letters will be securely ordered

within the syllable to which it belongs, and the spatial order of the syllables will be given by the temporal order in which they are perceived. Thus, just as Mewhort and Beal (1977) have theorized, syllabic parsing would occur during scanning; the system is supposed to encode the syllables from left-to-right and, in so doing, to convert their spatial order into a temporal one.

Of course, the viability of this schema really rests on the assumption that orthographic redundancy is higher within than between syllables. And this is where, at last, the importance of the vowels may be discovered. Because of their very redundancy they ensure the integrity of the syllable. The vowel corresponds to the vocalic center of the syllable and every written English syllable must include at least one. Because the vowels constitute nearly 40% of the letters in running text and because there are so few of them, the left-to-right transition probability from any given consonant to a vowel is bound to be relatively high. A quick glance at Mayzner and Tresselt's (1965) table of bigram frequencies confirms this conjecture.

On the assumption that syllable boundaries will be located where the associations between adjacent letters are weakest, the significance of this observation is that the

system will virtually never try to delimit as a syllable any string that does not include a vowel. More specifically, the implication is that the system will virtually never locate a syllable boundary in the midst of a CV pair. In contrast, as the vowels are relatively indifferent as to what letters they may precede, the associative link between a VC pair is expected, in general, to be of intermediate strength. Since it is the relative strengths of the interletter associations to which the system responds, this means that the system will tend to parse strings consisting of [...VCV...] into [...V-CV...]. That is, the system will recognize such words as major, preface, and cumulate as consisting of multiple syllables and will parse them as ma-jor, pre-face, and cu-mu-late.

If the probability that a consonant will be followed by one of the six major vowels is quite high, then the probability that it will be followed by any one of the twenty other letters of the alphabet must be quite low. Again, a glance at Mayzner and Tresselt's table confirms that, with a few predictable exceptions (e.g., ck, gh, ng, th), the frequency with which any consonant is followed by any other consonant is much lower than the frequency with which it is followed by any vowel. This means that the associative

linkage of an orthographic string will be especially weak between consonant pairs. Thus, the system will typically parse [...VCCV...] strings as [...VC-CV...]. For example, rabbit and advent will be encoded as rab-bit and ad-vent.

Because some consonant pairs are quite frequent and because there is considerable entropy in the VC pairs, I suspect that the system will parse some [...VCCV...] strings as [...V-CCV...]. However, the most frequent consonant bigrams correspond either to single phonemes (e.g., ch, th) or to phonemes that are frequently coarticulated (e.g., st, fr, bl). Thus, when [...V-CCV...] parsings do occur, they are more likely to capture than to distort the true syllabic structure of the word.

Finally, when more than two consonants occur in sequence, the system will locate the syllable boundary within the least likely pair. For many such cases, the pair that spans the syllable boundary will be very much less likely than any of the others, since it will, unlike the others, be relatively free of coarticulation constraints. Thus, sumptuous, thoughtful, and franchise will be encoded as sump-tuous, thought-ful, and fran-chise.

In short, the potential of this schema for syllabifying long words in the course of perception, looks very good from an armchair perspective. Even so, a great advantage of the schema is that the way in which it would parse any given word can be objectively specified through statistics. We have not yet tested the theory in this way, but we hope to do so in the near future.

From here, it looks as though the parsings that this schema will yield are generally the same as those posited by Smith and Spoehr's (1974) theory. Nevertheless, I believe that this schema improves on Smith and Spoehr's grammar in several ways. First, the assumption that syllabic parsing proceeds concurrently with letter identification -- that it is mediated by the same knowledge and processes that guide the organization of visual features into letters -- is consistent with Mewhort and Beal's (1977) findings that syllabic structure influences the scanning process. In contrast, according to Smith and Spoehr's theory parsing is begun only after visual feature extraction has been completed. Second, the hypothesis that syllable boundaries are located on the basis of the relative strength of the associations between letters obviates the need for classifying letters as consonants or vowels prior to their identification. I have

always felt that the latter requirement injected a hint of circularity into Smith and Spoehr's theory. The notion that syllable boundaries correspond to weak associative links is also more flexible than Smith and Spoehr's grammar of permissible consonant-vowel sequences. Under Smith and Spoehr's theory, less common parsings, such as [...V-CCV...] instead of [...VC-CV...], can only be obtained through sequential application and testing of secondary parsing rules. In contrast, under the present schema, either of these parsings may be produced immediately; which of them is, will depend on the relative transition probabilities between the pairs of letters. Further, Smith and Spoehr's (1974) theory has general difficulty with syllable boundaries that fall within a pair of vowels. The present schema is expected to have difficulty parsing words like naive and react, where the syllable boundary falls within a very common vowel digraph. But then, so do people (Adams, Huggins, Starr, Rollins, Zuckerman, Stevens, & Nickerson, 1980). On the other hand, the present schema should have no difficulty in splitting relatively infrequent vowel digraphs, such as those in chaos, giant, duet, and creosote.

The algorithm of parsing words as a function of relative transition probabilities is qualitatively different from Taft's (1979) parsing principle. According to Taft, the

system should "include in the first syllable as many consonants following the first vowel of the word as orthotactic factors will allow without disrupting the morphological structure of that word" (p. 24). Whether the present schema can compete with Taft's principle in predicting empirical results is yet to be learned. However, there is at least one class of words which, though troublesome for Taft's principle, would be correctly and readily parsed by the present schema. Examples of this class of words are cowlneck vs. cowlick, cornice vs. corncob, handsome vs. handsbreadth, country vs. countless, and costly vs. costive.

The schema is not expected to do a perfect job at parsing words into syllables. But then, it doesn't need to if, as increasing evidence suggests, words are stored in memory in both holistic and in morphologically decomposed states (e.g., Gibson & Guinet, 1971; Murrell & Morton, 1974; Osgood & Hoosain, 1974; Stanners, Neiser, Hernon, & Hall, 1979; Stanners, Neiser, & Painton, 1979; Taft & Forster, 1975). Top-down influences from the lexicon should compensate for ambiguities left by the parsing process.

In any case, if the hypothesis I have offered approaches truth, it carries some fairly satisfying theoretical implications. First, and foremost with respect to the theme

of this paper, it provides an explanation for the utility of orthographic redundancy. Second, it provides an explanation for the correlation between knowledge of orthographic redundancy and reading proficiency. Third, we have long appreciated the fact that written English is both an alphabet and a logography. The present hypothesis fills in the gap. It suggests, as Rozin & Gleitman (1977) have suggested before, that written English is in reality a three tiered system: It is at once an alphabet, a logography, and a syllabary. This insight adds meaning to our knowledge that logographies and syllabaries have not, in history, been abruptly displaced by alphabetic scripts, but instead, have evolved gradually into them.

References

Adams, M. J. Models of word recognition. Cognitive Psychology, 1979, 11, 133-176. (a)

Adams, M. J. Some differences between good and poor readers. In M. L. Kamil & A. J. Moe (Eds.), Reading research: Studies and applications. Clemson, S.C.: National Reading Conference, 1979. (b)

Adams, M. J., Huggins, A. W. F., Starr, B., Rollins, A., Zuckerman, L., Stevens, K., & Nickerson, R. A prototype test of decoding skills (BBN Report No. 4316). Prepared for the National Institute of Child Health & Human Development, Bethesda, Md., 1980.

Aderman, D., & Smith, E. E. Expectancy as a determinant of functional units in perceptual recognition. Cognitive Psychology, 1971, 2, 117-129.

Aukerman, R. C. Approaches to beginning reading. New York: Wiley, 1971.

Baron, J., & Thurston, I. An analysis of the word-superiority effect. Cognitive Psychology, 1973, 4, 207-228.

Barron, R. W. Access to the meanings of printed words: Some implications for reading and for learning to read. In F. B. Murray (Ed.), The recognition of words. Newark, Del.: International Reading Association, 1978. (a)

Barron R. W. Reading skill and phonological coding in lexical access. In M. M. Gruneberg, P. E. Morris, & R. N. Sykes (Eds.), Practical aspects of memory. London: Academic Press, 1978. (b)

Biederman, G. B. The recognition of tachistoscopically presented five-letter words as a function of digram frequency. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 208-209.

Broadbent, D. E. Word-frequency effect and response bias. Psychological Review, 1967, 74, 1-15.

Broadbent, D. E., & Gregory, M. Visual perception of words differing in letter digram frequency. Journal of Verbal Learning and Verbal Behavior, 1968, 7, 569-571.

Brooks, L. Visual pattern in fluent word identification. In A. S. Reber & D. L. Scarborough (Eds.), Toward a psychology of reading. Hillsdale, N.J.: Erlbaum, 1977.

Bryden, M. P. Left-right differences in tachistoscopic recognition as a function of familiarity and pattern orientation. Journal of Experimental Psychology, 1970, 84, 120-122.

Carroll, J. B., Davies, P., & Richman, B. Word frequency book. New York: American Heritage, 1971.

Chomsky, N. Phonology and reading. In H. Levin & J. P. Williams (Eds.), Basic studies on reading. New York: Basic Books, 1970.

Estes, W. K. Interactions of signal and background variables in visual processing. Perception & Psychophysics, 1972, 12, 278-286.

Estes, W. K. The locus of inferential and perceptual processes in letter identification. Journal of Experimental Psychology: General, 1975, 104, 122-145. (a)

Estes, W. K. Memory perception, and decision in letter identification. In R. L. Solso (Ed.), Information processing and cognition: The Loyola symposium. Hillsdale, N. J.: Erlbaum Associates, 1975. (b)

Estes, W. K. On the interaction of perception and memory in reading. In D. LaBerge, & S. J. Samuels (Eds.), Basic processes in reading. Hillside, N.J.: Erlbaum, 1977.

Estes, W. K., Allmeyer, D. H., & Reder, S. M. Serial position functions for letter identification at brief and extended exposure durations. Perception & Psychophysics, 1976, 19, 1-15.

Forster, K. I., & Chambers, S. M. Lexical access and naming time. Journal of Verbal Learning and Verbal Behavior, 1973, 12, 627-635.

Frederiksen, J. R. Assessment of perceptual decoding and lexical skills and their relation to reading proficiency. In A. M. Lesgold, J. W. Pellegrino, S. D. Fokkems, & R. Glaser (Eds.), Cognitive psychology and instruction. New York: Plenum Press, 1978.

Gerstman, L. Classification of self-normalized vowels. In IEEE Transactions on Audio and Electroacoustics, 1968, AU-16, 78-80.

Gibson, E. J., & Guinet, L. Perception of inflections in brief visual presentation. Journal of Verbal Learning and Verbal Behavior, 1971, 10, 182-189.

Gibson, E. J., Pick, A., Osser, H., & Hammond, M. The role of grapheme-phoneme correspondence in the perception of words. American Journal of Psychology, 1962, 75, 554-570.

Gibson, E. J., Tenney, Y. J., Barron, R. W., & Zaslow, M. The effect of orthographic structure on letter search. Perception & Psychophysics, 1972, 11, 183-186.

Gleitman, L. R., & Rozin, P. The structure and acquisition of reading I: Relations between orthographies and the structure of language. In A. S. Reber & D. L. Scarborough (Eds.), Toward a psychology of reading. Hillsdale, N.J.: Erlbaum, 1977.

Glushko, R. J. Principles for pronouncing print: The psychology of phonography. In C. Perfetti & A. Lesgold (Eds.), Interactive processes in reading. Hillsdale, N.J.: Erlbaum, 1980, in press.

Groff, P. Research in brief: Shapes as cues to word recognition. Visible Language, 1975, 9, 67-71.

Hanna, J. S., & Hanna, P. R. Spelling as a school subject: A brief history. National Elementary Principal, 1959, 38, 8-23.

James, C. T., & Smith, D. E. Sequential dependencies in letter search. Journal of Experimental Psychology, 1970, 85, 56-60.

Johnson, N. G. On the function of letters in word identification: Some data and a preliminary model. Journal of Verbal Learning and Verbal Behavior, 1975, 14, 17-29.

365-370.

Johnston, J. C. A test of the sophisticated guessing theory of word perception. Cognitive Psychology, 1978, 10, 123-153.

Johnston, J. C., & McClelland, J. L. Perception of letters in words: Seek not and ye shall find. Science, 1974, 184, 1192-1194.

Jorm, A. F. The cognitive and neurological basis of developmental dyslexia: A theoretical framework and review. Cognition, 1979, 7, 19-33.

Kleiman, G. M. Speech recoding and reading. Journal of Verbal Learning and Verbal Behavior, 1975, 14, 323-339.

Kolers, P. A. Buswell's discoveries. In R. A. Monty & J. W. Senders (Eds.), Eye movements and psychological processes. Hillsdale, N.J.: Erlbaum, 1976.

Krueger, L. E. Search time in a redundant visual display. Journal of Experimental Psychology, 1970, 83, 391-399. (a)

Krueger, L. E. Visual comparison in a redundant display. Cognitive Psychology, 1970, 1, 341-357. (b)

Krueger, L. E. Features versus redundancy: Comments on Massaro, Venezky, and Taylor's "Orthographic regularity, positional frequency, and visual processing of letter strings." Journal of Experimental Psychology: General, 1979, 108, 125-130.

Krueger, L. E., Keen, R. H., & Rublevich, B. Letter search through words and nonwords by adults and fourth-grade children. Journal of Experimental Psychology, 1974, 102, 845-849.

LaBerge, D., & Samuels, S. J. Toward a theory of automatic information processing in reading. Cognitive Psychology, 1974, 6, 293-323.

Levy, B. A. Vocalization and suppression effects in sentence memory. Journal of Verbal Learning and Verbal Behavior, 1975, 14, 304-316.

Levy, B. A. Speech processing during reading. In A. M. Lesgold, J. W. Pellegrino, S. D. Fokkems, & R. Glaser (Eds.), Cognitive psychology and instruction. New York: Plenum Press, 1978.

Liberman, I. Y., Shankweiler, D., Liberman, A. M. Fowler, C., & Fischer, F. W. Phonetic segmentation and recoding in the beginning reader. In A. S. Reber & D. L. Scarborough (Eds.), Toward a psychology of reading. Hillsdale, N.J.: Erlbaum, 1977.

Massaro, D. W. Primary and secondary recognition in reading. In D. W. Massaro (Ed.), Understanding language: An information processing analysis of speech perception, reading, and psycholinguistics. New York: Academic Press, 1975.

Massaro, D. W., & Taylor, G. A. Reading ability and the utilization of orthographic structure in reading (Tech. Rep. No. 515). Madison: University of Wisconsin, Wisconsin Research and Development Center for Individualized Schooling, July 1979.

Massaro, D. W., Venezky, R. I., & Taylor, G. A. Orthographic regularity, positional frequency, and visual processing of letter strings. Journal of Experimental Psychology: General, 1979, 108, 107-124.

Mayzner, M. S., & Tresselt, M. E. Tables of single-letter and digram frequency counts for various word-length and letter position combinations. Psychonomic Monograph Supplements, 1965, 1(Whole No. 2), 13-32.

McClelland, J. L. Preliminary letter identification in perception of words and nonwords. Journal of Experimental Psychology: Human Perception and Performance, 1976, 2, 80-91.

McClelland, J. L., & Johnston, J. C. The role of familiar units in perception of words and nonwords. Perception & Psychophysics, 1977, 22, 249-261.

Mewhort, D. J. K. Accuracy and order of report in tachistoscopic identification. Canadian Journal of Psychology, 1974, 28, 383-398.

Mewhort, D. J. K., & Beal, A. L. Mechanisms of word identification. Journal of Experimental Psychology: Human Perception and Performance, 1977, 3, 629-640.

Miller, G. A. The magical number seven, plus or minus two. Psychological Review, 1956, 63, 81-97.

Miller, G. A., Bruner, J. S., & Postman, I. Familiarity of letter sequences and tachistoscopic identification. Journal of General Psychology, 1954, 50, 129-139.

Miller, G. A., & Friedman, E. A. The reconstruction of mutilated English texts. Information and Control, 1957, 1, 38-55.

Miller, G. A., Newman, E. B., & Friedman, E. A. Length-frequency statistics for written English. Information and Control, 1958, 1, 370-389.

Morton, J. Interaction of information in word recognition. Psychological Review, 1969, 76, 165-178.

Murrell, G. A., & Morton, J. Word recognition and morphemic structure. Journal of Experimental Psychology, 1974, 102, 963-968.

Osgood, C. E., & Hoosain, R. Salience of the word as a unit in the perception of language. Perception & Psychophysics, 1974, 15, 168-192.

Rice, G. A., & Robinson, D. O. The role of bigram frequency in perception of words and nonwords. Memory & Cognition, 1975, 3, 513-518.

Rozin, P., & Gleitman, L. R. The structure and acquisition of reading II: The reading process and the acquisition of the alphabetic principle. In A. S. Reber & D. L. Scarborough (Eds.), Toward a psychology of reading. Hillsdale, N.J.: Erlbaum, 1977.

Rumelhart, D. E., & Siple, P. Process of recognizing tachistoscopically presented words. Psychological Review, 1974, 81, 99-118.

Savin, H. B., & Bever, T. G. The nonperceptual reality of the phoneme, Journal of Verbal Learning and Verbal Behavior, 1970, 9, 295-302.

Shannon, C. E. A mathematical theory of communication. The Bell System Technical Journal, 1948, 27, 379-423.

Smith, F. Understanding reading. New York: Holt, Rinehart & Winston, 1971.

Smith, F. Psycholinguistics and reading. New York: Holt, Rinehart & Winston, 1973.

Smith, E. E., & Spoehr, K. T. The perception of printed English: A theoretical perspective. In B. H. Kantowitz (Ed.), Human information processing: Tutorials in performance and cognition. Potomac, Md.: Erlbaum , 1974.

Spoehr, K. T. Word recognition in speech and reading: Toward a single theory of language processing. In P. D. Eimas & J. L. Miller (Eds.), Perspectives on the study of speech. Hillsdale, N.J.: Erlbaum, 1980.

Spoehr, K. T., & Smith, E. E. The role of syllables in perceptual processing. Cognitive Psychology, 1973, 5, 71-89.

Spoehr, K. T., & Smith, E. E. The role of orthographic and phonotactic rules in perceiving letter patterns. Journal of Experimental Psychology: Human Perception and Performance, 1975, 104, 21-34.

Stanners, R. F., Neiser, J. J., Hernon, W. P., & Hall, R. Memory representation for morphologically related words. Journal of Verbal Learning and Verbal Behavior, 1979, 18, 399-412.

Stanners, R. F., Neiser, J. J., & Painton, S. Memory representation for prefixed words. Journal of Verbal Learning and Verbal Behavior, 1979, 18, 733-743.

Stanovich, K. E., & Bauer, D. N. Experiments on the spelling-to-sound regularity effect in word recognition. Memory and Cognition, 1978, 6, 410-415.

Taft, M. Lexical access via an orthographic code: The basic orthographic syllabic structure (BOSS). Journal of Verbal Learning and Verbal Behavior, 1979, 18, 21-39.

Taft, M., & Forster, K. I. Lexical storage and retrieval of prefixed words. Journal of Verbal Learning and Verbal Behavior, 1975, 14, 638-647.

Tzeng, O., Hung, D., & Wang, W. Speech recoding in reading Chinese characters. Journal of Experimental Psychology: Human Learning and Memory, 1977, 3, 621-630.

Warren, R. M. Identification times for phonemic components of graded complexity and for spelling of speech. Perception & Psychophysics, 1971, 9, 345-349.

Webster's new collegiate dictionary. Springfield, Ma: G. & C. Merriam, 1973.

Wijk, A. Rules of pronunciation for the English language. London: Oxford University Press, 1966.

Wolford, G. Perturbation model for letter identification. Psychological Review, 1975, 82, 184-199.

Woodworth, R. S. Experimental psychology. New York: Holt, 1938.

Footnotes

[1]If this model is correct, it suggests another explanation for the failure of studies like McClelland and Johnston's (1977) to obtain significant effects of orthographic structure. Specifically, the strength of the interletter facilitation should depend, not on simple bigram frequency, but on the conditional probability of the ordered bigram given the occurrence of either of its component letters.

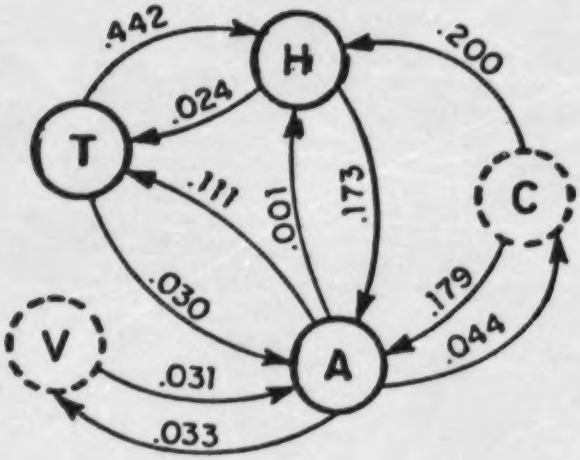
[2]The purpose of the first variation on this theme is to demonstrate that the transparency of the notation decreases precipitously when the text is composed of relatively infrequent words and becomes virtually impenetrable if words are not semantically or syntactically primed, viz., porcupine, dracula, turnip, castanet, nonsense.

Figure Captions

Figure 1. Schematic of the associated letter network (from Adams, 1979a).

Figure 2. Schematic of the associated lexical network (from Adams, 1979a).

STIMULUS



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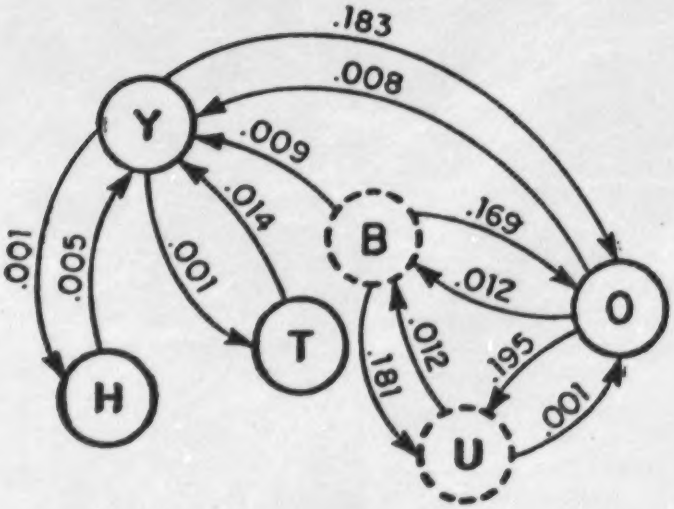

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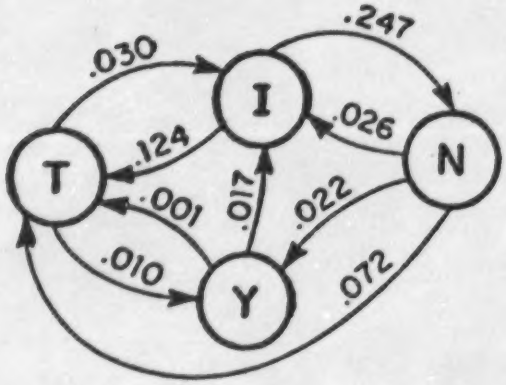

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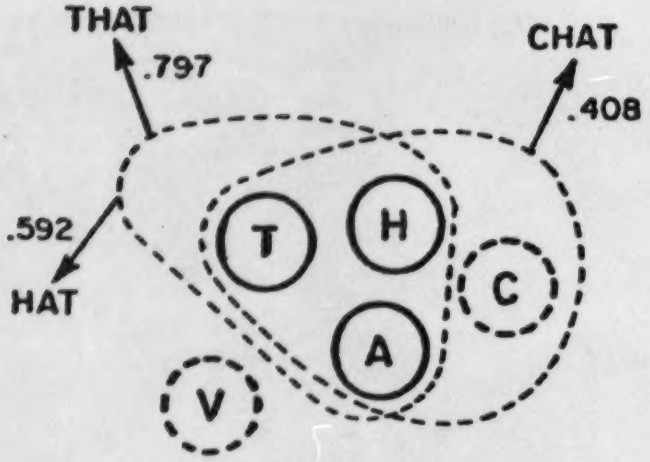

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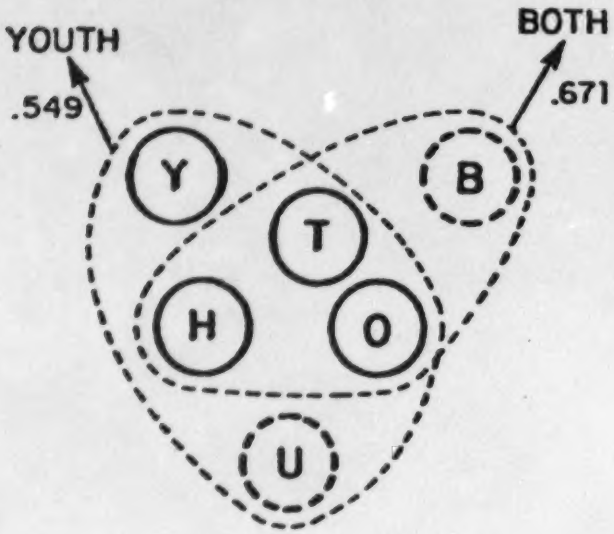

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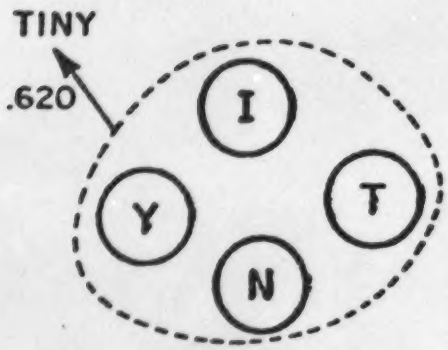

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